

Chapter 4



Ozone Concentrations

CASTNet is considered the principal source of information on rural O₃ concentrations in the United States. Ozone concentrations measured in 2000 were lower than in 1999 and several previous years. This result was caused by cooler and cloudier weather during the ozone season. The ozone measurements show considerable yearly variability but no overall trend.

Continuous O₃ concentrations were monitored throughout 2000 at 74 CASTNet sites. Based on the CASTNet siting criteria, the O₃ measurements are considered generally regionally representative and, therefore, able to define geographic patterns of rural O₃ across most of the United States. CASTNet, which includes the ozone sites supported by NPS and EPA, is considered the principal source of information on rural O₃ concentrations in the United States. However, as mentioned in Chapter 1, CASTNet QA procedures for EPA O₃ analyzers are different from SLAMS procedures; consequently, the O₃ data cannot be used to gauge compliance with ozone standards. However, all of these data are appropriate for use in establishing general status and trend patterns in regional O₃ levels, and for making general statements regarding the extent to which rural areas exceed the concentration levels associated with the standards.

This section provides information on hourly and 8-hour O₃ concentrations, SUM06 values collected in 2000, and trends over the 11-year period 1990 through 2000.

A National Ambient Air Quality Standard (NAAQS) for O₃ is in effect for second highest daily maximum 1-hour O₃ concentrations. EPA has proposed a new NAAQS for fourth highest daily maximum 8-hour O₃ concentrations. Previously, EPA had also proposed SUM06 as a secondary standard with a numerical limit of 25 ppm-hours. SUM06 is a measure of vegetation and crop exposure to O₃ during the growing season. CASTNet provides O₃ data to address the 1-hour NAAQS, the proposed 8-hour NAAQS, and SUM06.

One-Hour Concentrations

Figure 4-1 shows the number of days in 2000 with hourly O₃ concentrations greater than or equal to 125 ppb. Five eastern sites and one site in California experienced days with measured 1-hour O₃ levels equal to or greater than 125 ppb.

The eastern sites included Abington, CT (ABT147), Washington's Crossing, NJ (WSP144), Beltsville, MD (BEL116), Georgia Station, GA (GAS153), and Alhambra, IL (ALH157). Joshua Tree National Monument, CA (JOT403) was the one western site. BEL116 and GAS153 were the only two sites with multiple days with concentrations above 125 ppb in 2000. The number of sites and the number of days with concentrations above 125 ppb were significantly fewer than in 1999.

Figure 4-2 presents the second highest daily maximum 1-hour values for 2000. Sites with no plotted concentration values have insufficient data. Concentrations greater than or equal to 125 ppb were observed in Maryland and in the greater Atlanta, GA area.

The magnitude and geographic extent of daily maximum 1-hour and 8-hour O₃ concentrations were smaller in 2000 than in 1999. Temperature and solar radiation data indicate that 2000 had a cooler, cloudier ozone season.

Eight-Hour Concentrations

The fourth highest daily maximum 8-hour O₃ concentrations measured in 2000 are presented in Figure 4-3. Approximately 27 percent of the eastern sites had 8-hour concentrations above 85 ppb. This percentage is much lower than the 75 percent observed in 1999. Only one site measured a concentration greater than 100 ppb. The highest 8-hour concentration (101 ppb) was measured at Sequoia National Park, CA (SEK402). The lowest concentrations in the continental United States were observed in the Northwest with the lowest concentration (47 ppb) measured at Olympic National Park, WA (OLY421).

SUM06

SUM06 is a measure of vegetation and crop exposure to O₃ during the growing season. EPA had proposed SUM06 as a secondary standard with a numerical limit of 25 parts per million-hours (ppm-hr). Although EPA concluded that an 8-hour limit of 0.08 ppm was an appropriate level for a

secondary standard, SUM06 provides an alternative measure of O₃ impact on vegetation and crops. SUM06 is calculated as the sum of hourly O₃ concentrations above 0.06 ppm summed over 12 hours (0800 to 2000) during a 3-month period.

Figure 4-4 shows peak SUM06 values for 2000. The peak values were taken as the maximum rolling 3-month SUM06 at each CASTNet site. Approximately 35 percent of the eastern sites and 42 percent of the western sites measured SUM06 above 25 ppm-hr. The geographic extent of the high values is significantly less than those observed in 1999.

Eleven-Year Trends

Figure 4-5 presents the 11-year trend in the second highest daily maximum 1-hour O₃ concentrations aggregated over the selected 34-station subset. The intersite variability is shown graphically by the 90th percentile, median, composite mean, and 10th percentile. Figure 4-6 shows the 11-year trend in the fourth highest daily maximum 8-hour O₃ concentrations and Figure 4-7 shows the trend in peak SUM06 values from the 34 sites. The figures show considerable yearly variability with relatively high concentrations during 1991, 1998, and 1999.

Meteorological measurements from the 34 eastern sites were analyzed to provide perspective to the distributions of O₃ concentrations. Figures 4-8 and 4-9 provide box plots of temperature and solar radiation measurements over the 11 years. The relationship between O₃ concentrations and meteorological conditions is evident from a comparison of the five figures (Figures 4-5 through 4-9). Relatively high O₃ concentrations occur during sunny, warm years; conversely, relatively low concentrations occur during cool, cloudy years. Much lower O₃ concentrations were observed during the eastern United States during 2000.

Daily maximum 8-hour O₃ concentrations and SUM06 values were lower in 2000 than in 1999. However, the SUM06 data show that many rural sites at high elevations received a high exposure to atmospheric ozone.

Note: In the following figures, the concentrations shading was prepared using an algorithm based on inverse distance cubed weighting with a radius of influence of 500 km. Consequently concentration estimates for areas near the geographic limits of site coverage have no meaning (e.g., western Missouri). Shading was not prepared for Alaska, Hawaii, and the Virgin Islands.

Figure 4-1. Number of Days with Hourly O₃ Concentrations Greater Than or Equal to 125 ppb for 2000



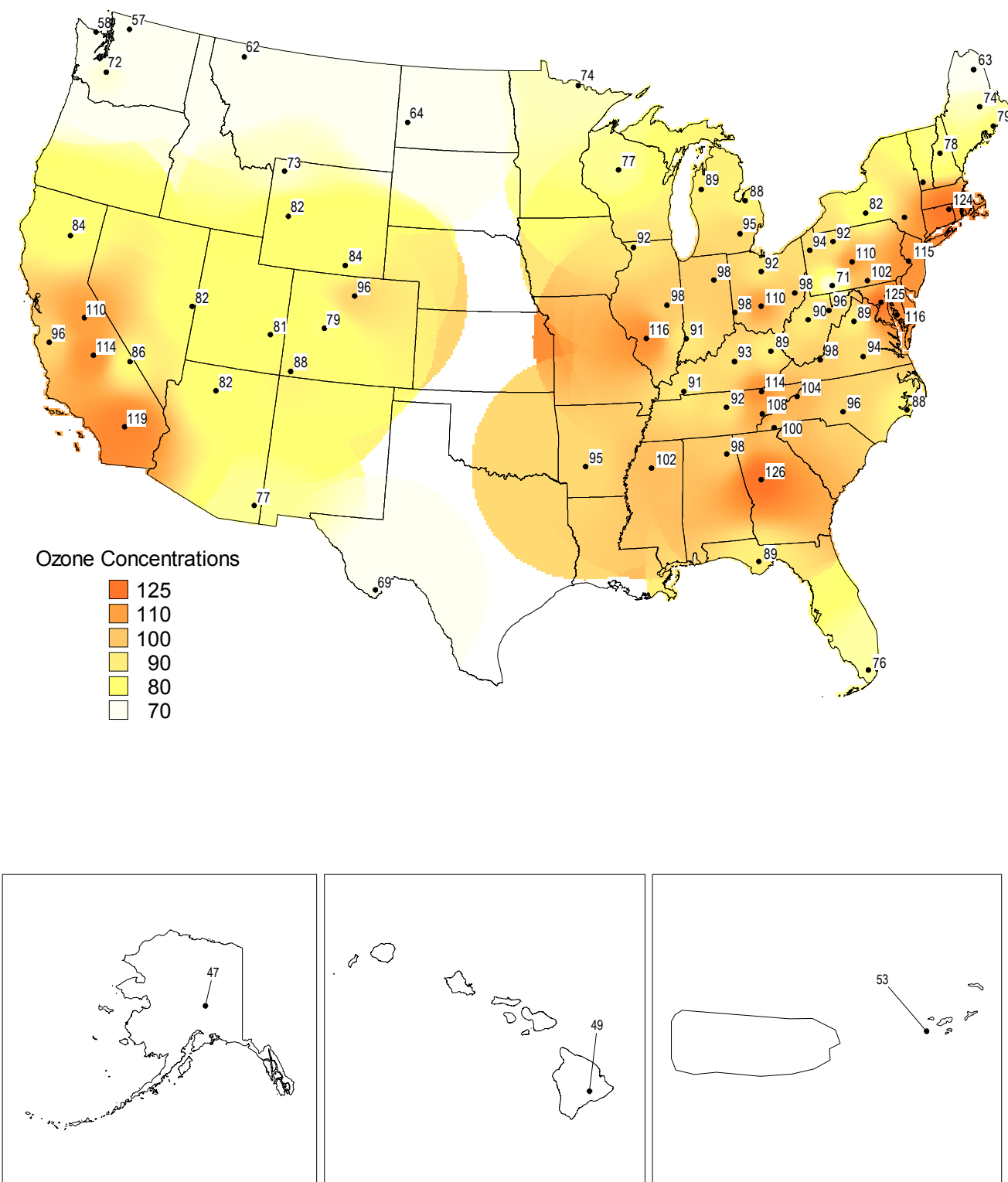
Figure 4-2. Second Highest Daily Maximum 1-Hour O₃ Concentrations (ppb) for 2000

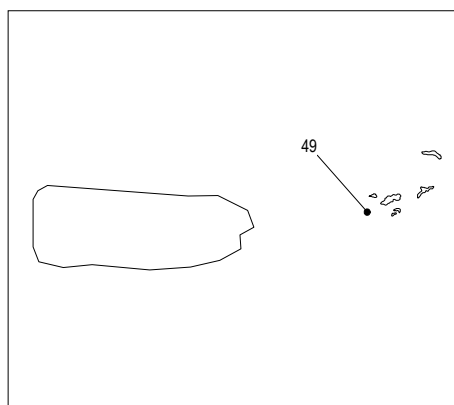
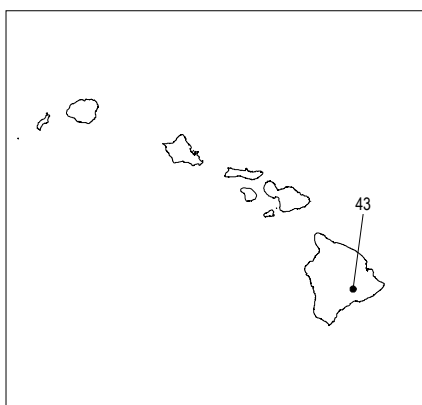
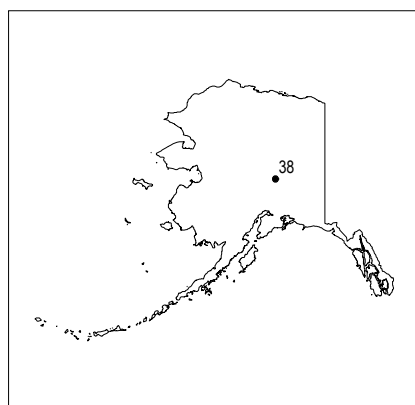
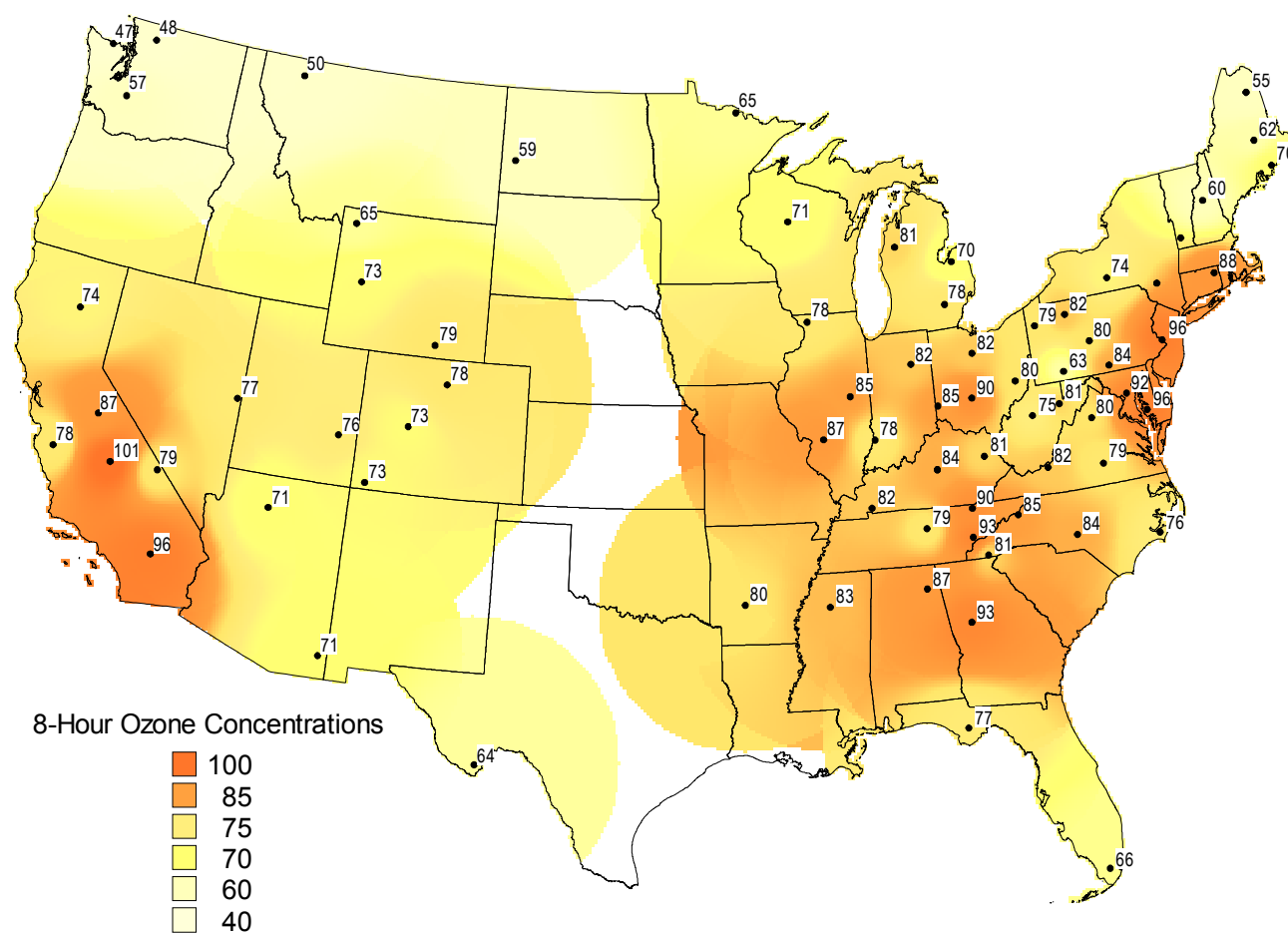
Figure 4-3. Fourth Highest Daily Maximum 8-Hour O₃ Concentrations (ppb) for 2000

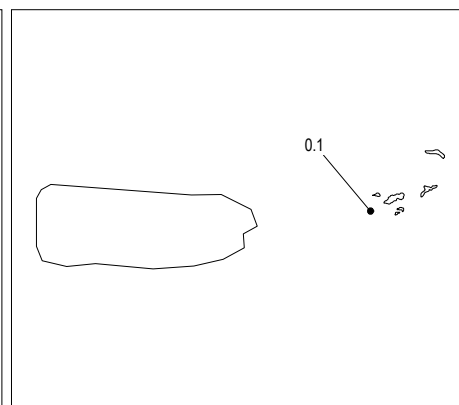
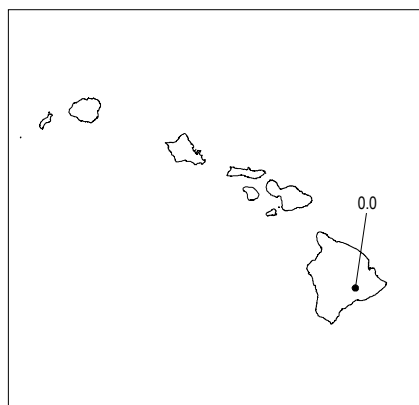
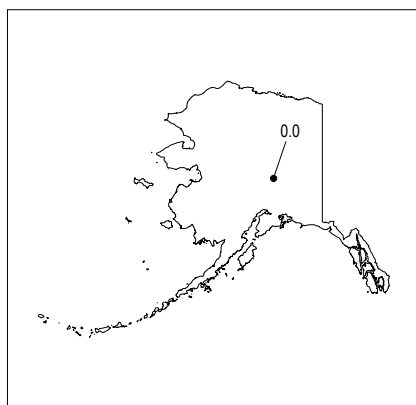
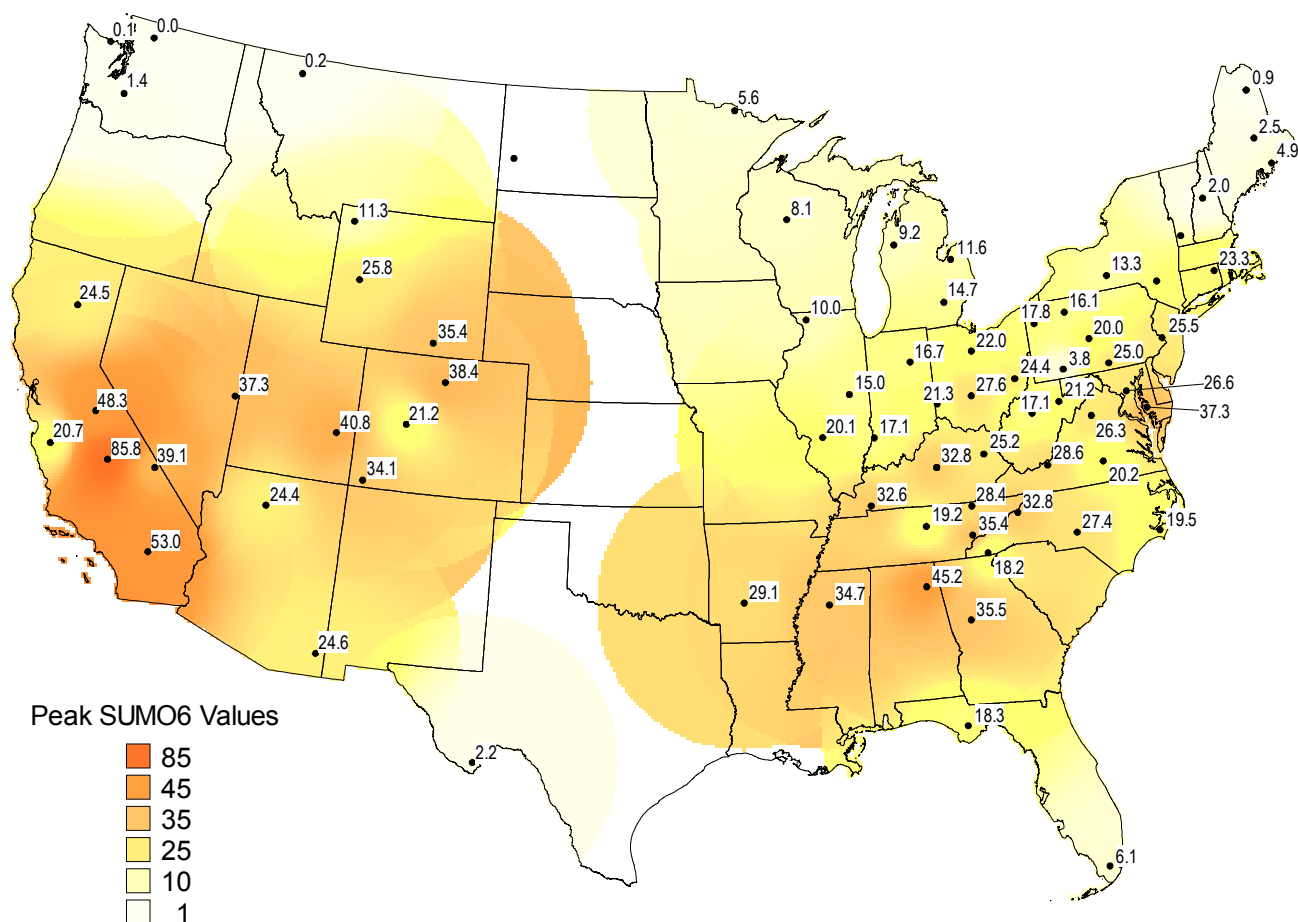
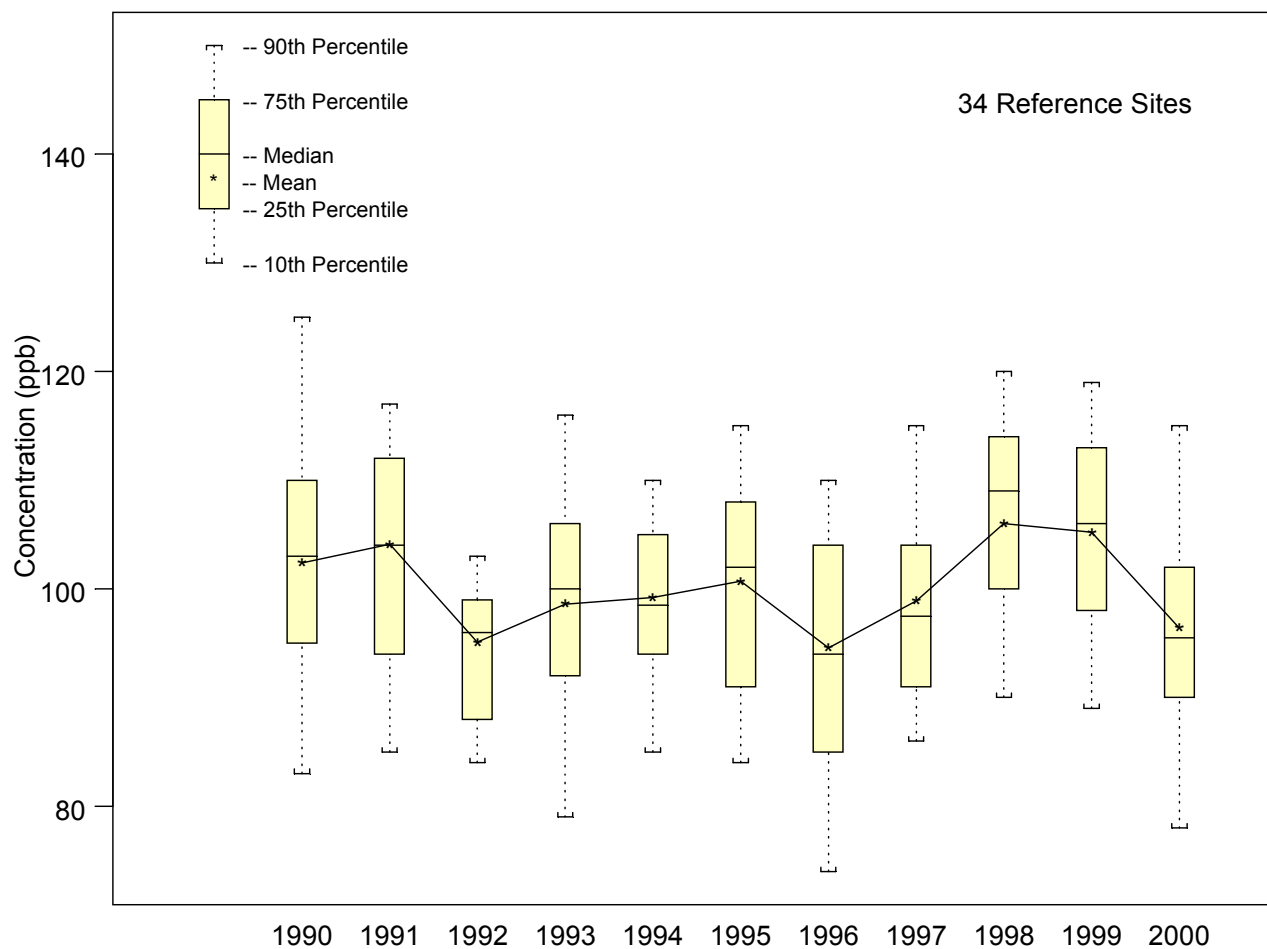
Figure 4-4. Peak SUM06 Values (ppm-hr) for 2000

Figure 4-5. Trend in Second Highest Daily Maximum 1-Hour O₃ Concentrations – Eastern United States

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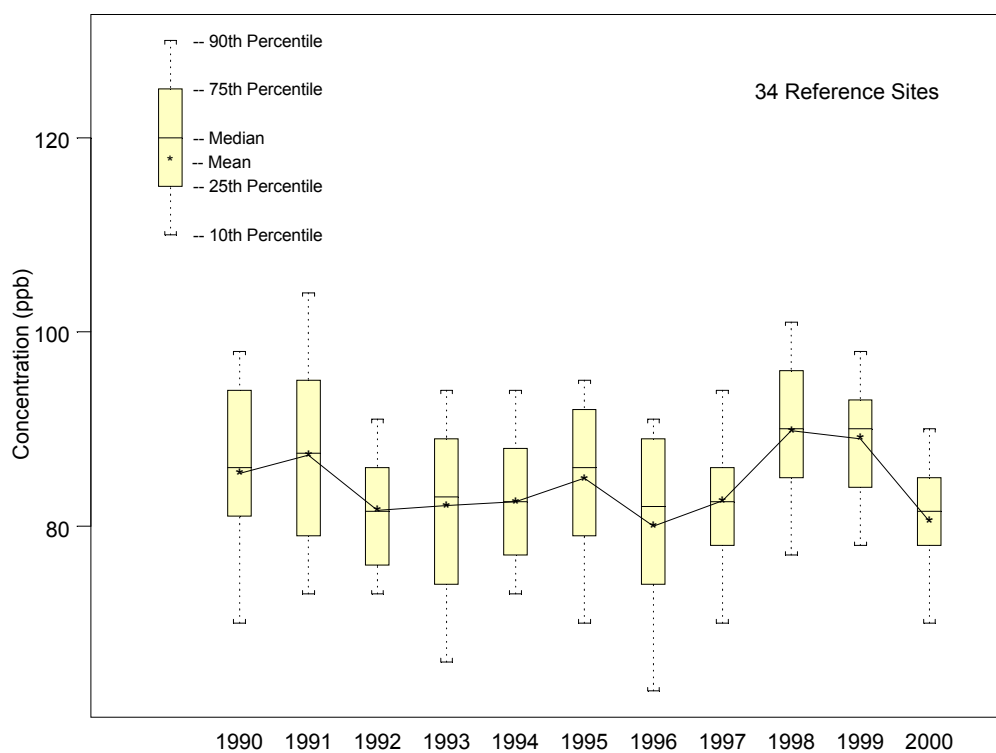
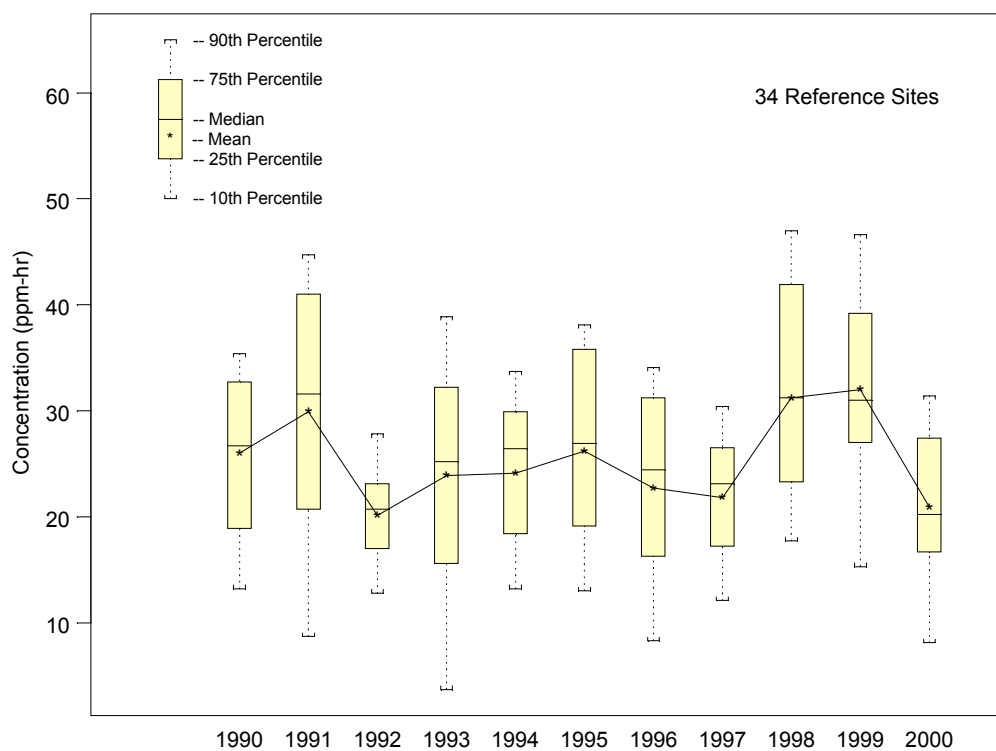
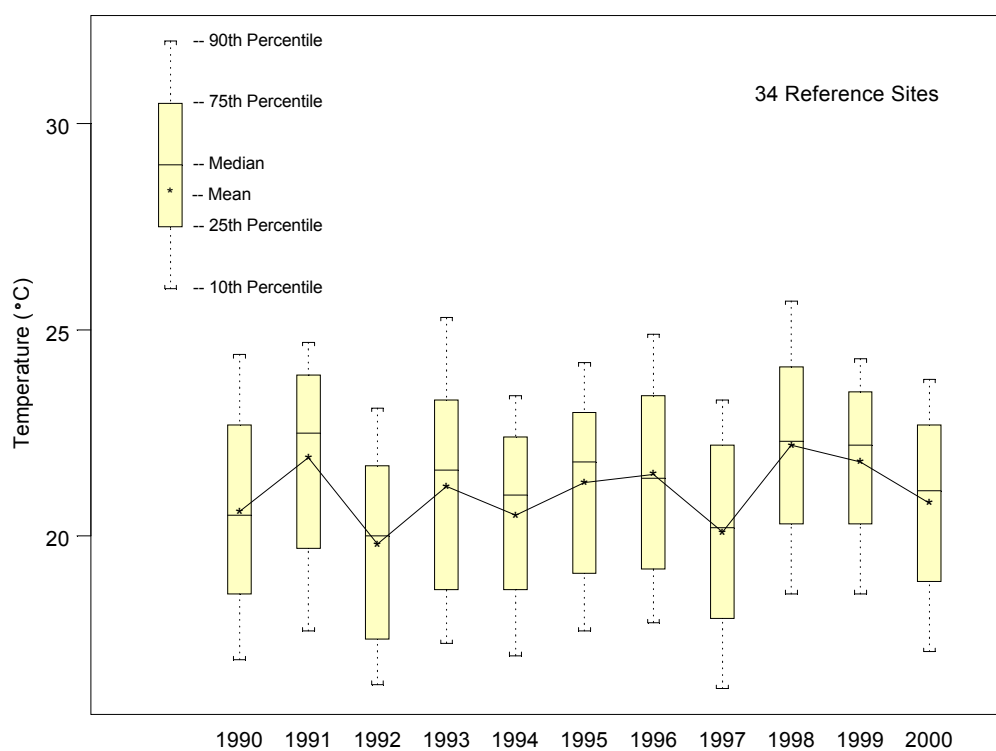
Figure 4-6. Trend in Fourth Highest Daily Maximum 8-Hour O₃ Concentrations – Eastern United States**Figure 4-7.** Trend in Peak SUM06 Values (ppm-hr) - Eastern United States

Figure 4-8. Trend in Temperature – Eastern United States**Figure 4-9.** Trend in Solar Radiation – Eastern United States